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The relationship of physical activity and overweight to objectively measured green space accessibility and use☆

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ABSTRACT

This study examines the association between objectively measured access to green space, frequency of green space use, physical activity, and the probability of being overweight or obese in the city of Bristol, England. Data from the 2005 Bristol Quality of Life in your Neighbourhood survey for 6821 adults were combined with a comprehensive GIS database of neighbourhood and green space characteristics. A range of green space accessibility measures were computed. Associations between accessibility and the odds of respondents achieving a recommended 30 min or more of moderate activity five times a week, or being overweight or obese, were examined using logistic regression. Results showed that the reported frequency of green space use declined with increasing distance. The study also found that respondents living closest to the type of green space classified as a Formal park were more likely to achieve the physical activity recommendation and less likely to be overweight or obese. The association with physical activity, but not with overweight or obesity, remained after adjustment for respondent characteristics, area deprivation, and a range of characteristics of the neighbourhood environment. The findings suggest that the provision of good access to green spaces in urban areas may help promote population physical activity.

Introduction

Despite the well recognised health benefits of regular physical activity and its role in reducing obesity, many people fail to achieve recommended activity levels; currently, only 37% of men and 24% of women in England and Wales meet the Chief Medical Officer's guidelines of 30 min of moderate exercise at least five days a week (Department of Health, 2005). Furthermore, over 25% of adult men and women are currently obese or overweight in the UK, for which physical inactivity is a well established risk factor (Pietiläinen et al., 2008). These figures are predicted to rise to over 50% in 2050 if current trends continue (Butland et al., 2007).

There is increasing evidence that the environment may play a role in influencing physical activity levels (Jones, Bentham, Foster, Hillsdon, & Panter, 2007). In particular, recent research has suggested that the provision of open spaces, such as parks and other green spaces, for recreation may provide an important place for people to be active (Macintyre, Macdonald, & Ellaway, 2008), especially in urban areas where gaining access to the open countryside can be difficult (Maas, Verheij, Groenewegen, de Vries, & Spreeuwenberg, 2006). Mitchell and Popham (2008), recently highlighted lower levels of circulatory and all-cause mortality amongst English populations with the most green space in their surroundings, and a number of recent policy documents have promoted their potential benefits (e.g. CABE, 2004; National Heart Forum, 2007, p. 69).

Several studies have examined the relationship between distance to green spaces and participation in physical activity. Giles-Corti et al. (2005) found that proximity to public open space was associated with higher levels of walking amongst residents in Perth, Australia. However, Hoehner, Brennan Ramirez, Elliott, Handy, and Brownson (2005) found no relationship between living within a 5 min walk from a green space and meeting physical activity guidelines in the USA, and Hillsdon, Panter, Foster, and Jones (2006) found no relationship between distance to green spaces and self reported leisure time physical activity amongst a cohort of adults in an English city. Studies that have measured the availability of green space within the neighbourhoods of participants, have drawn similarly equivocal conclusions; in the Netherlands, Maas, Verheij, Spreeuwenberg, and Groenewegen (2008) found no association between green space area and physical

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activity levels in adults, whilst Roemmich et al. (2006) identified a strong relationship for children in the USA. Conflicting findings have also emerged from studies that have examined the correlation between green space availability and bodyweight. For example, Potwarka, Kaczynski, and Flack (2008) found no relationship between proximity to parks and overweight in Canadian children, while Nielsen and Hansen (2007) identified a significant association for Danish adults. These conflicting findings might reflect the diverse and complex influences on bodyweight, which include dietary behaviours as well as physical activity.

Overall, there is some evidence to suggest that improving access to green space in urban areas could provide public health benefits by encouraging greater participation in physical activity and thus reducing risks for obesity. However, many of the studies from which the current research evidence is drawn suffer from a number of key limitations. First, research findings have often been based solely on the perceived accessibility of green spaces, whilst perceptions have recently been shown not to correlate well with objective measures (Macintyre et al., 2008). Second, several studies have been limited by the lack of a comprehensive database on publicly accessible green space locations and hence have been unable to measure the potential opportunities for green space use amongst their participants. Third, few researchers have been able to capture information on the attributes of green spaces and in particular, the types of activity that each may be particularly suitable for. Finally, very few studies have recorded the frequency with which participants actually make use of the green spaces in their area.

This study aims to provide new evidence on the association between objectively measured access to green space, frequency of green space use, physical activity levels, and the probability of being overweight or obese by combining information from the Bristol Quality of Life in your Neighbourhood Survey, undertaken amongst a large sample of adults from the city of Bristol, UK with a comprehensive database of green space locations and characteristics within the city.

Methods

The survey

Data from the 2005 Quality of Life in your Neighbourhood Survey, a cross-sectional postal survey used to facilitate planning within Bristol (UK) were accessed. The survey includes information on residents' perceptions and opinions about their local community, their lifestyle, health, and also some personal details including their home postcode. The study population was selected from the 393,900 adults resident in Bristol (Bristol City Council, 2005), an area with a mix of inner-city and suburban, and affluent and more socio-economically deprived neighbourhoods. By employing the Electoral Register for Bristol (a list of all individuals eligible to vote) a single-stage sampling frame was developed based on the 35 electoral wards (medium sized census tracts) in the city. An equal size population from each ward was sampled (380 persons), with the exception of the 12 most deprived wards which were oversampled (950 persons) due to an anticipated lower response rate (Bristol City Council, 2005). This provided a total sample of 20,140 individuals. Although the electoral register does not contain the age of respondents, only those aged over 16 appear on it, so the sample excluded children. No information on household membership was available, so more than one member of some households may have been approached. Each person was sent a questionnaire to complete and return by post, and there was one postal reminder which included a duplicate questionnaire. Overall there were 6821 respondents, equating to a response rate of 34%.

Outcomes

Survey respondents were requested to state their frequency of green space use (''How often do you visit Bristol's parks and green spaces?'') with response frequency categories ranging from ''5 times a week or more'' to ''less than once a year''. They were also asked about participation in sport (''How often do you take part in active sport for 30 min or more?''), with response categories ranging from ''5 times a week or more'' to ''never'', and moderate physical activity (''How often do you take part in moderate exercise where you are active for 30 min or more, or in two 15 min sessions?''). Examples of moderate exercise given were brisk walking, gardening, heavy housework or DIY, and the same response categories were offered. In addition they were asked to report their height and weight, and these were used to calculate their Body Mass Index (BMI). Three main outcomes were examined in this study: (i) the frequency with which visits were made to green space, (ii) the odds of achieving the Chief Medical Officer's (CMO) guidelines for physical activity (at least 5 sessions of 30 min or more a week), and (iii) the odds of being overweight or obese.

As it is frequent exercise that has been shown to have health benefits, for outcome (i), the response scale was collapsed into a dichotomous variable where respondents were coded as ''1'' if they visited a green space at least once a week and ''0'' otherwise. For the computation of outcome (ii), the two measures of physical activity participation were combined to produce a single variable which was coded as ''1'' where respondents participated in either sport or moderate physical activity at least 5 times a week and ''0'' otherwise. For outcome (iii), respondents were classified as being overweight or obese if they had a calculated BMI of 25 or above, based on recommendations of the World Health Organisation (1995), and normal weight otherwise. A sensitivity analysis was undertaken to determine the effect of redefining the outcome to identify only those respondents classified as obese (BMI of 30 or above), but the results were not substantively different from those presented here, and are hence not reproduced.

Explanatory variables

Respondent characteristics

Information on age, gender, and self-rated health, which was rated as 'good', 'fairly good', or 'not good', was obtained from the questionnaire. Respondent's individual socioeconomic position was derived from their education level and employment status. The survey recorded highest education level attained and this was used to group respondents according to whether they had no qualifications, had completed GCSEs (aged 16), A-levels (aged 18), or a university degree. Employment status was reported as full time employment, part time employment (16–30 h per week), retired, or 'other', which included students, those looking after the home or caring for another person with an illness, and the unemployed. These categories were combined to produce a dichotomous variable which was coded as '1' for those in either full or part time employment, or '0' otherwise.

Green space access measures

Respondent's home locations were mapped using the ArcGIS 9.2 Geographical Information System (GIS) package (ESRI, California). Home locations were identified based on postcodes using the Ordnance Survey Code-Point database (Ordnance Survey, 2009a). The measure of green space accessibility computed in the GIS was the distance by road from the residential location of each respondent to the nearest green space of each type considered (Table 1).

The locations of all public green spaces within Bristol were mapped using a GIS database of their locations and attributes